7. In the Mammal—an Aardwolf—the worms were encysted pentastomata, which were in large numbers all over the body, causing pleuritis and peritonitis. In the Birds they were mostly syngamus.

8. Under Malaria are grouped cases in which intracorpuscular parasites belonging either to the *Halteridium* or *Proteosoma* group have been found in sufficient numbers to cause death.

9. In a Bulbul in which 60 per cent. of the polynuclear leucocytes were infected. This I believe to be new.

10. Most of these occurred during the first and last three months of the year; 4 of them were badly rickety.

11. Nine of the Mammals had bad rickets also. The number of cases amongst Birds, in which it is relatively much more fatal, is slightly less than last year.

12. In most of the Mammals it was caused by food-poisoning, in others, and in the Birds and Reptiles, by worms burrowing into the mucosa.

13. In 7 Mammals, 59 Birds, and 1 Reptile the enteritis was hæmorrhagic; in 6 Birds and 6 Reptiles it was due to worms; and in 9 Birds and 1 Mammal it was due to foreign bodies. This disease is a little less prevalent than last year.

14. Two very extreme intussusceptions occurred in two Wombats, recent arrivals, which came together.

15. In a Coypu Rat, in which 27 stones were found.

16. Four of these cases of cancer were in Wallabies, the stomach in all was the seat of the primary growth; the fifth was in a Markhoor in the mouth.

17. Two Gazelles died from sarcoma, one of liver and one of mediastinal glands.

18. This occurred in a Jungle-fowl and was of the spleno-medullary variety.

19. In a Partridge and Marsh-Bird, both not described before.

20. In a Bat, in which all the wing-joints were affected.

16. A Contribution to the Study of the Variations of the Spotted Salamander (*Salamandra maculosa*). By Edward G. Boulenger*.

[Received December 10, 1910: Read February 21, 1911.]

(Plate XV.† & Text-figures 99–102.)

The experiments now being carried out in Vienna by Dr. Kammerer on the colour-changes of the Spotted Salamander (*Salamandra maculosa*) in relation to its environment are attracting attention, and it has occurred to me that a general survey of what is known of the varieties of this very variable species, especially in connection with the geographical distribution,

* Communicated by G. A. Boulenger, F.R.S., V.P.Z.S.

† For explanation of the Plate see p. 347.

would not be without importance at the present moment. Such a survey would afford those who wish to follow the path opened up by Dr. Kammerer a more precise basis than can be obtained from the available literature on the subject. I have therefore, with the help of my father, undertaken a revision of the rich material in the British Museum and have now the honour of offering an account of it for publication to the Zoological Society.

One of the principal results of my study has been to lay greater stress on the disposition of the markings than on their actual size, form, or colour, and to define two principal forms in Central Europe, which previous authors have not separated with sufficient precision, in spite of their well-marked geographical segregation.

Except in the case of var. *molleri*, with its aberrant coloration, authors dividing *S. maculosa* into a number of subordinate forms have dwelt on real or supposed structural characters, whilst ignoring the disposition of the markings. Bedriaga (3, p. 98), the most recent writer on the subject, recognizes, apart from the typical form, also called by him var. *europæa* (2, p. 252), three varieties, namely—var. *algira*, var. *corsica*, and var. *molleri*, the two former based only on slight structural differences, which are, besides, not constant, as I intend to show further on. Under the designation of typical form authors have generally thrown together specimens with different styles of markings, either simply observing that these are subject to infinite variation or classifying them under a number of titles, which refer merely to individual variations, such as the var. *tæniata*, var. *quadrivirgata* and var. *nigriventris*, proposed by Dürigen (10, pp. 577 & 578) for certain individuals. In order to avoid introducing a new name, I will adopt the first of these for the assemblage which I have endeavoured to define and contrast with the typical spotted form on which the name *maculosa* is based.

To better bring out the individual differences to which the markings are subjected in this Salamander, I have drawn up tables of a certain number of the specimens in the British Museum, upon a scheme which should prove of use to those making experiments on the colour-changes, as by that means a record of each individual specimen, out of a large number, can be kept in such a way as to ensure its future identification. Such tables, explained by the annexed diagram (text-fig. 99), do not, however, convey an exact representation of the markings, which can only be done by descriptions, but they will be found to answer well enough for the purpose of identification.

In defining the varieties into which the species *Salamandra maculosa* may be divided, I have not lost sight of occasional exceptions, and have duly pointed them out. There are always exceptions, especially when we have to deal with forms of subspecific rank, but such as I have come across are too few to militate against the adoption of a var. *tæniata* as opposed to the forma *typica*.

In the tables the explanation of the various columns is as

follows:—The length of each specimen (in millimetres) is taken from the end of the snout to the posterior extremity of the vent.

O means presence (+) or absence (−) of the supraocular spot (on the upper eyelid).

P, the spot on the parotoid gland.

S, spot or spots on the snout.

Text-fig. 99.

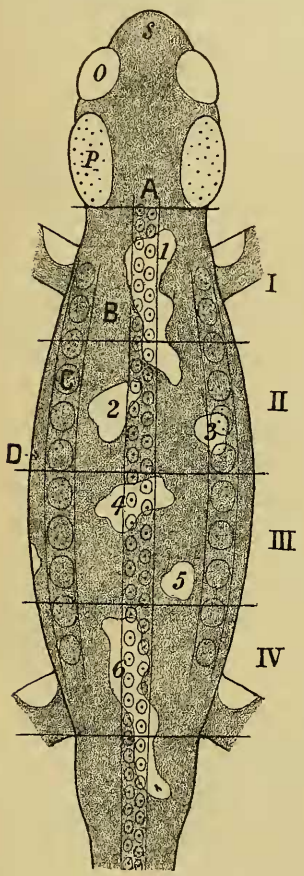


Diagram to explain the tables of different markings in *Salamandra maculosa*.

OP, OS, whether the above-mentioned spots are confluent or not. PB, whether or not the spot on P is confluent with one on the body. In cases where the two sides differ, the initials R (right) and L (left) indicate the discrepancy.

Sp., total number of spots on the upper surface of body (to a line connecting the posterior borders of the hind limbs), which is divided into four conventional segments, numbered I, II, III, IV; under each of the latter figures, the spots pertaining to each segment are given. These spots are numbered 1, 2, 3, &c., in the order shown on the diagram; in case of absolute symmetry, the spots are numbered from right to left.

A stands for the vertebral area, bearing the two median rows of glands. B (right and left) for the area between A and C; C (right and left) for the area occupied by the series of large lateral glands; D for the area between the latter and the limit of the belly (taken from an imaginary line connecting the lower border of the axil with the groin). In column D, right and left sides are separated by a —, the figures referring to the number of spots on each side (spots confluent with the ventrals and dorsals not reckoned), not to the individual spots as in the columns A to C.

G, presence (+) or absence (−) of yellow spots on the chin and gular region.

V, on the ventral region of the body.

The tabulation of the markings on the specimen represented in text-fig. 99 may be drawn up as follows :—

							Section.				Area.				
O	OP	P	PB	S	OS	Sp.	I.	II.	III.	IV.	C	B	A	B	C
+	—	+	—	—	—	6	1	1.2.3	4.5	6	—	1.2.4.6	1.2.4.6	1.3.4.5.6	3

The following is a list of the specimens preserved in the British Museum and the Lataste Collection, arranged geographically under varieties :—

Forma typica.

France.

1. ♂.	Beure, near Besançon.	Mme. Phisalix.
2. ♂.	Avignon.	M. M. Mourgue.
3. ♀.	Basses-Alpes.	M. Honnorat. Lataste Collection.
4. ♂.	S.E. France.	Prof. Duboscq.

Corsica.

5–9. ♀ & yg.	Bocognano.	Dr. J. de Bedriaga.
10. Yg.	Vizzavona (1100 m.).	Prof. Vayssière.
11. Yg.	Corsica.	Dr. J. de Bedriaga. Lataste Collection.

Germany.

12. ♂.	Near Stuttgart.	Prof. K. Lampert.
13. ♀.	Ballenstadt, E. Harz.	Dr. W. Wolterstorff.
14–15. ♂ ♀.	Sharfenberg, near Meissen, Saxony.	,,

Switzerland.

16–17. ♂ ♀.	Near Lausanne.	W. Morton, Esq.
18. Hgr.	Flüelen, Uri (465 m.).	M. A. Ghidini.
19. ♂.	Lugano, Ticino (275 m.).	,,
20. ♂.	Val Bavano at Cavergno, Ticino (ca. 600 m.).	,,

Italy.

21. ♂.	Prego, Brianza, L. Como.	Dr. C. Vandoni.
22. ♀.	Tuduno Olona, Varese.	,,
23–24. ♀.	Olginate, Prov. Lecco, Lombardy.	,,
25–54. ♂.	Cascinella, near Borgoli, Prov. Genoa.	Dr. R. Gestro.
55. ♂.	Viterbo.	Prof. J. J. Bianconi.
56–60. ♂ ♀.	Prov. Rome.	Prof. Carruccio.
61. ♀.	Aspromonte, near Reggio, Calabria (1600 m.).	Prof. O. Neumann.

Austria-Hungary.

62–63. ♂ ♀.	Hütteldorf, near Vienna.	Dr. F. Werner.
64–66. ♂ ♀ & yg.	Near Prague.	G. A. Boulenger, Esq.
67. ♀.	Brasso, Hungary.	Prof. L. v. Méhely.
68. Yg.	Teszla, Bozau Mts., Hungary.	,,
69–88. ♂ ♀.	Nagy Becskerek, Hungary.	Hr. A. v. Kovács.
89. ♂.	Hungary.	
90. ♀.	Sarajen, Bosnia.	Dr. F. Werner.
91–92. ♂.	Travnik, Bosnia.	,,

Roumania.

93. ♂.	Near Azu, Carpathians of Moldavia.	M. A. Montandon.
94–113. ♂ ♀ & yg.	Sinaia, Carpathians of Vallachia.	„

Greece.

114. Yg.	Parnassus.	Dr. T. Krüper.

Asia Minor.

115. ♀.	Zebel Bulgar Dagh, Cilician Taurus (1200 m.).	C. G. Danford, Esq.

Algeria.

116–118. ♀ & yg.	Mt. Edough, near Bona.	Dr. Hagenmüller.
119–122. ♂ ♀ & yg.	„ „	„ Lataste Collection.
123. Yg.	„ „	M. L. Bedel. „
124. ♀.	L'Arba, near Algiers.	M. Lallemant. „
125. ♂.	Algeria.	

Morocco.

126–133. ♀ & yg.	Benider Hills, near Tangier.	M. H. Vaucher.

Vars. GALLAICA and MOLLERI.

Spain.

1. ♀.	Vigo, Galicia.	M. V. L. Scoane.
2–5. ♂ ♀ & yg.	Galicia.	„ Lataste Collection.
6–11. ♂ ♀ & yg.	Loroya Valley, near Madrid (300–400 m.).	M. de la Escalera.
12. Yg.	Spain.	Lord Lilford.

Portugal.

13. ♀.	Coimbra.	Dr. J. de Bedriaga.
14–17. ♂ ♀.	„	
18–19. ♂ ♀.	Cintra.	Col. Yerbury.
20. ♀.	Near Lisbon.	Sr. Mattozo Santos.

Var. TÆNIATA.

France.

1. ♀.	Near St. Malo.	G. A. Boulenger, Esq.
2–5. ♂ ♀.	Roscoff, Finistère.	„
6–8. ♀ & yg.	Near Rouen.	M. Louis Müller.
9. ♀.	„	M. L. Horst.
10. ♀.	Armainvilliers, near Paris.	M. E. Simon. Lataste Collection.
11–13. ♂.	Haute-Marne.	Dr. A. Pettit.
14–19. ♂ ♀.	Beure, near Besançon.	Mme. Phisalix.
20. ♀.	Bourg-en-Gironde.	Lataste Collection.
21–26. ♂ ♀.	Hérault.	Prof. Duboscq.
27. Yg.	Aix-les-Thermes, Ariège.	M. V. Baillet.
28. ♂.	Eaux-bonnes, Basses-Pyrénées.	Rev. F. A. Walker.

Belgium.

29–30. ♂ ♀.	Maredsous, Prov. Namur.	Rev. B. Lebbe.
31. ♂.	Waulsort, „	G. A. Boulenger, Esq.

Luxemburg.

32. ♀.	Luxemburg.	M. V. Ferrant.

Germany.

53–40. ♂ ♀ & yg.	Ilsenberg, Harz.	Dr. W. Wolterstorff.
41. ♀.	" "	W. H. Decks.
42–51. ♂ ♀.	Harz.	Zoological Society.
52–53. Yg.	"	G. A. Boulenger, Esq.
54–55. ♂ ♀.	Vorwohle, Brunswick.	Dr. W. Wolterstorff.
56–58. ♂ ♀.	Holzminden, Brunswick.	"
59–60. ♂ ♀.	Stadtoldendorf, Brunswick.	M. A. Ghidini.
61–63. ♂ & yg.	Lippe-Detmold.	Dr. J. Roux.
64–67. ♂ ♀ & yg.	Near Stuttgart.	Prof. K. Lampert.
68. ♂.	G. Duchy of Baden.	Basle Museum.

Switzerland.

69–72. ♂ ♀ & yg.	Langenbruck, Jura.	Basle Museum.
73. ♂.	St. Gallen.	M. A. Ghidini.

Portugal.

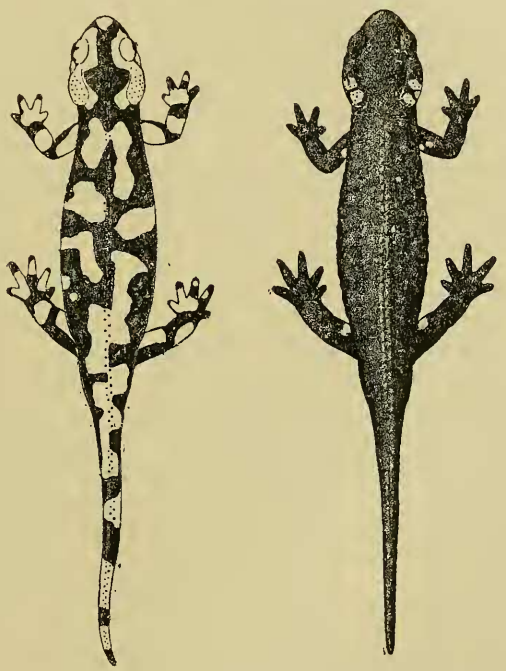
74–75. ♂ & yg.	Oporto.	E. Allen, Esq.
76–77. ♂.	Portugal.	P. B. Webb, Esq.

I. The Typical Form.

This form deserves to be regarded as the typical, not only because the name *maculosa* applies best to it, but because it is the only one found in Austria (*cf.* Werner, **32**, p. 119), where it was described under that name by Laurenti (**18**, pp. 42, 151). It also happens to be the form figured by most authors :—Aldrovandi (**1**, p. 641), Rösel (**24**, frontispiece), Latreille (**17**, pl. i.), Sturm (**30**), Reider & Hahn (**23**), Funk (**12**, pl. l.), Bonaparte (**5**), Rusconi (**25**, pl. i.), and Camerano (**6**, pl. i.). It corresponds to the vars. A and C of Duméril and Bibron (**9**, p. 37), *a–c* of Schreiber (**27**, p. 75). In this form the black nearly always greatly predominates over the yellow, the latter appearing as markings of various shapes,—round, elongate, **C**-, **S**-, **Y**-shaped, &c., and disposed over the body, often in 3 to 5 alternating series, or with a median series forming a sinuous or zigzag vertebral stripe. If, as is very exceptionally the case, the dorsal spots appear to form two longitudinal series, it will be observed that they by no means hang together in regular chains continuous with the spots on the parotoids. Only in one specimen (from Lausanne) have I felt embarrassed as to the form to which it should be referred. Upper eyelid and parotoid usually entirely, sometimes only partially, yellow, the spots on the parotoid may even be entirely absent (specimens from Algeria and Morocco). The two spots thus located are, as a rule, distinct, but may occasionally run together. In a specimen from Nagy Begskerek, Hungary, the yellow markings on the upper eyelids extend across the interorbital region, forming a cross-bar. The sides usually bear spots, which may number up to 15, in which case they are, of course, very small. A spot above the angle of the mouth is absent in only about 5 per

cent. of the specimens. Gular region with a few large or small markings, sometimes completely unspotted. Below entirely black or with spots which are usually of small size, the only specimens with very large spots being single ones from Genoa, Viterbo, and Reggio in Italy. Snout generally entirely black. Limbs black, with a characteristic yellow blotch on the upper surface of the arm and thigh, near the base, which is constantly present; a second on the forearm and leg may or may not also be present. Hand and foot entirely black or with one or two (rarely more) yellow spots, which, as a rule, are not confluent with the spot on the forearm and leg. Single or paired spots on the tail, which may run together to form a stripe. Under surface of tail nearly always black.

Text-fig. 100.



a *q*

Forma *typica*.

The colour of the bright markings varies from chrome-yellow to a deep orange. I have found traces of claret-red on the head in some specimens from Genoa. The usual absence of yellow on the snout has been mentioned above; the only exceptions I have noted are to be found in specimens from Lausanne, Avignon,

Corsica, Genoa (7 specimens out of 40), the province of Rome, and Calabria. The latter is remarkable for the large size of the yellow markings on the upper and lower surfaces, where they almost equal in extent the black area. The opposite extreme occurs in a specimen from the Val Bavano, Ticino, in which the yellow colour is reduced to a few very small blotches on the parotoids and at the base of the limbs. These two extremes are figured side by side in text-fig. 100.

On careful examination of the specimens of var. *algira* Bedriaga and var. *corsica* Savi, I have come to the conclusion that they are not essentially different from the forma *typica*.

The var. *algira* is described by Bedriaga (3, p. 111) as having the tail and digits longer and more slender than in the typical form; but the specimens from Mt. Edough (in the Lataste Collection), upon which Bedriaga based his observations, are in a rather emaciated condition, having, no doubt, been kept in captivity for some considerable time, and this is evidently partly the cause of their slenderness. Although the digits and tails of the Salamanders from Algeria and Morocco are, as a rule, longer than in the typical form, the longest digits in the latter may be actually longer in proportion to the length of the body. Thus, in a specimen from Lake Como, the length of the longest toe is $9\frac{1}{2}$ per cent. of the total length (from tip of snout to posterior end of vent), while in a specimen from Mt. Edough, Algeria, the length of the same is 9 per cent., and in one from the Benider hills, Morocco, as low as $6\frac{1}{2}$ per cent. Again, the length of the tail in var. *algira* ranges from 65 to 81 per cent. of the length of the body, against 54 to 78 in the forma *typica*, an overlap which precludes the character being used as diagnostic.

In the same author's description of the Corsican variety, the head is stated to be remarkably broad, and the toes to be much more strongly depressed and with sharper edges on the sides than in the typical form. I have examined the very specimen described by Bedriaga, but do not find the head to be any broader than in some of the typical and striated forms, and although the toes are more depressed than is generally the case, they are not more so than in certain specimens from Vienna, Bosnia, Luxemburg, and the Harz Mountains. As to the more sharply edged sides of the toes, this sharpness simply coincides with the degree of depression.

The supposed difference in the palatine dentition, on which *S. corsica* was founded by Savi (26), has long ago been disposed of by Schreiber (27), Bedriaga (2), and Camerano (6).

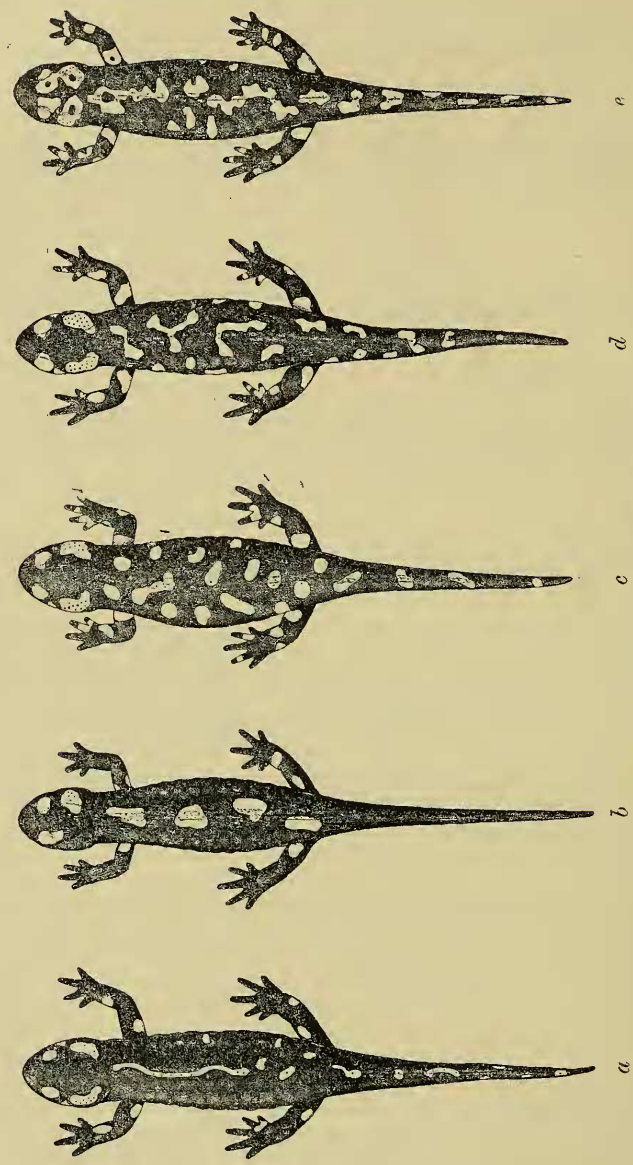
The habitat of the typical form seems to be bounded to the west by the Erz Mountains, the Danube, the Alps, and the Rhone, all the specimens from east and south of that line belonging to it, with a few exceptions mentioned below. All over France, west and north of the Rhone, the var. *tæniata*, described further on, alone occurs (with rare exceptions from the Doubs), whence it extends to Northern Spain (Bilbao, *fide* Bedriaga) and Portugal (Oporto, Brit. Mus.).

I. Forma *typica*.

	Sex.	Length	O	OP	P	PB	S	OS	Sp.	SECTION I.	SECTION II.	SECTION III.	SECTION IV.	AREA C.	AREA B.	AREA A.	AREA B.	AREA C.	D.	G.	V.
1.	♂	161	+	—	+	+	+	—	9	1.2	3.4	5.6.7	8.9	5	1.4.6.8	4	2.3.4.7.9	4.3	3—1	+	+
2.	♀	100	+	÷	+	—	—	—	4	1	1.2	2.3	4	3.4	1.3.4	1.4	1.2.4	2	4—3	+	+
3.	♂	127	+	+R	+	—	+	+	23	1–6	7–11	12–17	17–23	2.13.15.19.20	3.9.12.13.17	3.5.8.12.13. 21.23	3.11.14.21.22	1.4.6.7.10. 16.18.22	7—8	+	+
4.	—	43	+	—	+	—	—	—	7	1.2	3.4	5.6	7	—	2.4.6	1.2	3.5	5.7	3—2	—	—
5.	♂	100	+	—	+	—	—	—	9	1–3	2.4.5.6	6–8	8.9	6	2.6.7.8	6	1.3.4.6.9	5	5—2	+	—
6.	♀	95	+	+R	+	—	+	—	13	1–3	4–8	6.9–11	12.13	8.11	2.4.6.9.12.13	2.7	1.3.7.10.14	5	3—3	+	+
7.	♂	95	+	—	+	—	—	—	6	1.2	2	3–5	6	—	1.2	1.2.4.5.6	2.4	3	0—0	+	—
8.	♀	95	+	—	+	—	—	—	6	1	1	1–3	4–6	—	—	1.3.5	3.6	2.4	2—3	+	+
9.	♂	90	+	—	+	+L	+	+	6	1.2	3.4	5	6	5.6	1.4.5.6	5.6	2.3.6	3	0—0	+	+
10.	♂	86	+	+	+	+	+	+	3	1	1	1.2	3	—	1.2.3	1.2.3	1.3	—	0—0	+	+
11.	♀	78	+	+	+	—	+	+	5	1	1.2	3–5	5	2.4.5	1.2.4.5	1.2.4.5	1.3.5	3.5	0—0*	+	+
12.	♂	97	+	—	+	—	—	—	12	1–3	1.4.5	6–11	12	2.3.5.9	1.4.6.8.12	1.4.12	1.4.7.11.12	10	3—1	+	+
13.	♀	111	+	—	+	—	—	—	14	1–3	3–5	6–10	11–14	5.7.12	1.3.7.9.12.13	3.8.11.13	2.3.8.10.11.14	4.6	2—4	+	+
14.	♂	97	+	—	+	—	—	—	10	1.2	2–5	5–8	9.10	3.4.6	1.2.5.9	1.2.5	1.2.5.10	2.7.8	6—5	+	+
15.	♀	91	+	—	+	—	—	—	5	1	2.3	4	5	—	1.2.5	—	3.4	3	0—0	+	+
16.	♀	109	+	—	+	—	—	—	9	1–3	3.4	5.6	7–9	3.5.7	2.9	1.2.8	1.2.4.6.8	—	2—8	+	+
17.	♂	105	+	—	+	—	—	—	9	1.2	3–5	6–7	8.9	—	2.6.8	3.6	1.3.4.6.9	5.7	4—4	+	+
18.	♂	94	+	—	+	—	—	—	12	1.2	3–6	7–11	12	5.6	1.3.6.10.11	1.3.4.6.10.11	2.4.10.11	5.7.8.9	1—1	+	+
19.	♂	101	+	—	+	—	—	—	7	1.2	3	4	5–7	1.4	1.4.5.7	1	3.6	2.6	3—4	+	+
20.	♂	100	+	—	+	+R	—	—	5	1.2	2	2.3.4	4.5	—	2.3.4.5	2.4.5	1.2.4.5	—	2—2	+	—
21.	♂	100	+	—	+	—	—	—	7	1.2	3.4	5.6	6.7	—	2.3.5	—	1.4.6.7	6	3—3	+	+
22.	♀	98	+	—	+	—	—	—	7	1.2	2.3	3–5	5–7	6	1.3.7	1.3.5.7	2.4.5.7	—	2—2	+	—
23.	♀	97	+	—	+	—	—	—	8	1.2	3	4–6	7.8	—	2.3.5.7	3.5.8	1.3.4.6	6	2—0	+	—
24.	♀	78	+	—	+	—	—	—	3	1	2	3	3	1.3	1.2.3	1.2	1.2	2	1—1	+	+
25.	♀	133	+	+	+	—	—	—	7	1	1.2	4–6	6.7	2.3.5	1.3.5.6	1.6.7	1.6.7	4.6	12—14	+	+
26.	♂	111	+	+	+	—	—	—	5	1	1.2	3	3–5	2	1.2.3.4	1.2.3.4	1.3.4.5	5	0—0	—	—
27.	♀	97	+	+	+	—	—	—	5	1	2.3.4	4.5	5	—	1.2.4.5	1.2.3.4.5	1.3.4.5	—	7—5	—	—
28.	♀	91	+	—	+	—	—	—	8	1.2	3.4	5.6	7.8	—	1.3.5.6	2.3.5.7.8	2.4.5.7.8	—	0—0	—	—
29.	♂	96	+	—	+	—	—	—	10	1.2	1.3.4.5	6.7	8–10	3.5	1.7.10	1.6.7.8	1.6.9	2.4	3—4	+	+
30.	♀	91	+	—	+R	—	—	—	5	1	2.3	4	5	—	1.3.5	1.3.4.5	1.3.4	2	3—1	—	—
31.	♀	81	+	—	+	—	—	—	6	1	2–4	5	6	3	1.2.4.5.6	1.2.4.5.6	1.2.6	—	0—0	+	—
32.	♀	70	+	—	+L	—	—	—	4	1.2	2.3	3	4	—	1.2	1.2.3.4	3.4	—	0—0	+	—

* A large marking on the belly on the left side is confluent with spot No. 4 on the back.

1. Avignon.
2. Basses-Alpes.
3. Bocagnano, Corsica.
4. Vizzavona, „
5. Stuttgart.
6. Lausanne.
7. Lugano.
8. Varese, Lombardy.
9–10. Rome.
11. Aspromonte.
12–13. Hütteldorf, near Vienna.
14. Prague.
15. Brasso, Hungary.
16. Sarajen, Bosnia.
17–18. Travnik, Bosnia.
19–24. Sinaia, Roumania.
25. Zebel Bulgar Dagh, Asia Minor.
26–28. Mt. Edough, Algeria.
29. Algeria.
30–32. Benider Hills, Morocco.



Text-fig. 101.

The Spotted Salamander. Forma *typica*.

All the specimens hitherto examined from Belgium, North-Western Germany, and the Rhine are referable to that variety, which also prevails in Würtemberg (*cf.* Leydig, 19). Exceptions to the above geographical division occur to my knowledge near, or

not far from, the line of demarcation, as on Mt. Salève in Savoy, according to M. Ghidini, but possibly also in Italy near Rome, where, according to Duméril, the striped variety has been found (yellow on the back, with three black stripes, and a few scattered black spots on the limbs and belly)*. Further, a specimen referable to the typical form from Ballenstedt, Anhalt, received from Dr. Wolterstorff, one from the neighbourhood of Stuttgart, received from Prof. Lampert, and six exceptional specimens sketched by Mme. Phisalix: five from near Besançon, black above with irregular yellow blotches on the back, and one from Toulouse (Paris Museum), yellow above and below with irregular black markings on the back, a very aberrant specimen. One of these specimens, from Beure, near Besançon, has been presented by Mme. Phisalix to the British Museum, and is listed under the head of forma *typica*, whilst six others from the same locality appear under var. *tæniata*, thus showing that in the French Jura the latter variety is not so completely fixed as it appears to be in the North of France and Germany and Belgium.

Five specimens are represented on text-fig. 101 :—

a, from Varese, Lombardy, is remarkable for its small amount of yellow, and for its long and thin yellow vertebral stripe, extending from the nape to over halfway down the back. Sides and lower surface with only a few spots.

b, from the Benider hills, Morocco, with a small number of large roundish spots on the back, has the left parotoid entirely black.

c, from Hütteldorf, near Vienna, has a remarkably large number of spots. Flanks and sides of belly spotted.

d, from the neighbourhood of Prague, is a type with very irregular markings. Flanks and sides of belly with only a few large spots.

e, from Zebel, Bulgar Dagh, Asia Minor, has some of the spots ring-like, the yellow markings having a round black spot in the centre. Sides profusely spotted. Lower surface with many spots of small size.

The specimen figured on Plate XV. is a male from Lugano, Ticino, sent alive by M. A. Ghidini.

II. The Varieties of the Spanish Peninsula.

(Vars. *gallaica* and *molleri*.)

We have mentioned above that the var. *tæniata* occurs in Spain and Portugal. Specimens of that form, with the yellow colour predominating over the black, are stated to occur in the Peninsula by Schreiber (**27**, p. 78), and Bedriaga (**3**, p. 108)

* I am indebted to Mme. Phisalix for a sketch of this specimen preserved in the Paris Museum. It is not unlikely, however, that the locality under which it has been registered is erroneous, as neither de Betta (**4**), Camerano (**6**), nor Count Peracca (*in litt.*) have come across the striped variety in any part of Italy.

records such a one from Bilbao. But in addition we find highly remarkable specimens ranging from the form named var. *gallaica* by Seoane (29), which is hardly separable from the typical form, especially its North African representatives, to that named var. *molleri* by Bedriaga, which approaches very closely some specimens from near Genoa, from Austria, described by Kammerer (*cf.* p. 342), and from Oran, Algeria, described by Doumergue *. My father has already proposed to unite the var. *gallaica* with the var. *molleri*, a view in which Bedriaga (3, p. 109) could not concur, on the ground that Seoane's diagnosis does not at all agree with his own. It is, nevertheless, a fact that an almost uninterrupted series can be traced between the two varieties, and I think it advisable, provisionally at least, to regard them as extremes of one and the same form, which is completely linked with the typical form.

The following is a translation of Seoane's definition of the Spanish specimens (var. *gallaica*) :—"Differs from the typical form, among other characters, in the intense black of the ground-colour and the small number of yellow spots, distributed over the body."

The three specimens from Galicia (*Seoane*) in the Lataste Collection are remarkable for the very irregular, broken-up disposition of the spots on the back, a few of which are partly brownish and may have been edged with red or pink, in a manner similar to Bedriaga's var. *molleri*. The snout, supraocular and interorbital regions, partly yellow, partly reddish brown ; yellow on the throat somewhat predominating over the black; sides irregularly spotted with yellow. The number of spots on the dorsal region of these specimens is 9, 13, and 26 respectively. A specimen from Cabanas, Galicia (*Seoane*), preserved in the Paris Museum and of which a sketch has kindly been made for me by Mme. Phisalix, approaches very closely the Portuguese var. *molleri*. The British Museum specimen from Vigo differs, however, from all the above by being very scantily marked with

* Essai sur la Faune Erpétologique de l'Oranie (Oran, 1901), p. 372.

"Corps présentant en dessus plusieurs taches jaunes et rouges sans symétrie dont voici la distribution. Régions sus-oculaires jaunes en dessus et d'un rouge sang en avant et en arrière. Arcades sourcilières d'un noir rougeâtre. Parotides jaunes en dessus et aussi en dessous postérieurement, entourées de noir en avant; extérieurement elles sont bordées depuis l'œil jusque sur le cou, d'une longue et large tache rouge. Seules les taches des régions sus-oculaires et celles des parotides présentent quelque symétrie. Sur le cou se trouve une grande tache transversale échancrée en avant, à laquelle font suite, sur le dos, quatre taches irrégulières (de 7 mill. sur 3 en moyenne). Ces taches alternent entre elles et touchent la double ligne dorsale de tubercules ; elles sont à peu près à égale distance l'une de l'autre. Près de l'aisselle, sur le bras, il y a une petite tache jaune bordée de rouge ; une ou deux très petites, jaunes et rouges, se voient sur l'avant bras, et une seule sur les mains et les pieds. Le fond noir des flancs est parsemé de quelques points rouges. Membres postérieures tachés comme les antérieurs. En arrière de la ligne des cuisses, en dessus, commence une tache jaune, longue et étroite, qui s'étend en arrière; elle a 10 mill. sur 2 à 3. Sur la queue ou voit cinq séries de taches doubles, rondes, qui se rapprochent l'une de l'autre sur la ligne médiane supérieure ; elles sont jaunes et visiblement bien bordées de rouge, surtout celle placées vers le bout de la queue. Mamelon du cloaque taché de jaune de chaque côté. Dessous du corps d'un violet noirâtre. Pourtour inférieur de la bouche bordé de taches rouges qui s'étendent sur la gorge."

yellow, except on the gular region and on the sides of the belly. The back, snout, and interorbital region bear no distinct markings, but are speckled over with small yellowish dots. The parotoids and upper eyelids are almost entirely of a reddish-brown colour. This specimen must be regarded as an individual aberration of the form above described, an aberration tending to the total suppression of the bright markings.

Three specimens referable to the var. *gallaica* have been received from M. de la Escalera, who obtained them in the Loroya Valley, near Madrid, at an altitude of 300 to 400 metres. The spots are moderately large, few or moderately numerous (6 to 12), those on the parotoids being either confluent with or distinct from those on the upper eyelids and the dorsal region. The spot on the eyelid in one of these specimens is entirely of a reddish brown, that on the parotoid partly reddish, partly yellow. In this and another specimen the interorbital region is also reddish. The spot at the angle of the mouth in all three is brownish red in colour. Lower surface and sides black, minutely speckled over with yellow; throat spotted with red.

The true var. *molleri* is represented in the British Museum Collection by 7 specimens from Portugal (Coimbra and Cintra), including one of the types received from Dr. de Bedriaga, who has thus described its coloration :—

"The colour and pattern of this variety are rather variable. The ground-colour is usually a greyish brown, sometimes more of a dirty grey, sometimes more brownish black or even black, broken up above and below by pale yellow spots with an addition of grey or greyish-brown spots into which the yellow passes gradually. The yellow spots on the side of the body, on the limbs, on the tail, on the parotoids, on the throat, and on the eyelids are as if powdered over with red dust, or washed with red, or even blood-red. The throat may sometimes acquire a deep red colour; the dorsal spots show here and there a red dot. The yellow spots are very variable both in number and size; they may be either few, in which case they are large and roundish, or numerous and horseshoe- or ring-shaped, and forming six or eight more or less regular longitudinal series; some of these spots break up or run together, thus forming wavy bands. These spots may be so numerous as to greatly reduce the ground-colour; the yellow spots on the head are in that case the more conspicuous and a symmetrical or very ornamental pattern results."

My father has drawn up the following notes on living specimens exhibited in our Zoological Gardens, a few years ago.

"Some specimens were black, variegated with various tints of grey, brown, pale yellow, and crimson. The latter colour was particularly conspicuous on the upper eyelids, the parotoid glands, the base of the limbs, and on the throat, but it appeared also as small patches within the area of the more or less irregular pale yellow spots with grey centres, which were disposed very irregularly on the body and tail. One of the specimens was pale

olive-grey above and on the sides, freckled with black and with pale greenish-yellow spots; the black appeared as an irregular vertebral stripe, a dorso-lateral stripe, and bars on the flanks; the upper eyelids, the parotoids, and the throat were claret-red. The coloration of such a Salamander has a lichen-like aspect more suggestive of assimilation to the surroundings than of warning to enemies." Other specimens which he has seen since had but little or no red on them, but the yellow spots were greyish in the centre.

In his description of var. *molleri*, Bedriaga states that it differs from the typical form in the snout being more pointed and projecting beyond the lower jaw, also that the tail is shorter and thicker. In five out of eight specimens (including Bedriaga's type) examined by me, I found the snout to be more projecting than is usual in the other forms, although the most pointed snout I have seen is in a specimen from near Meissen, Saxony. I also found that the tail in four out of the eight specimens was stouter and shorter than usual in the typical form and the var. *tæniata*, and this is also to be noticed in the figure on Pl. XV. The length of the tail in each of the specimens (measured from the posterior end of the vent) was 55, 55, 57, 57, 63, 67, 67, 71, the length of the body being taken as 100 (tip of snout to posterior end of vent). The length of the tail in the typical form varies from 60 to 78, with an average of about 67, whilst in the var. *tæniata* it may fall as low as 54 (Besançon). It will be seen therefore, that there are many exceptions, and too much importance should not be attached to this character. I may add that the measurements of the Galician specimens, alluded to above under the name of var. *gallaica*, give 57, 66, 70, and 70 as the length of the tail, and those of the specimens from near Madrid 56, 65, and 70.

Thanks to the courtesy of the Hon. Walter Rothschild, I am able to give a figure (Pl. XV.) of the var. *molleri* from a sketch made for him by Mr. J. Green, from a female specimen in his possession exhibited a few years ago in the Zoological Gardens.

I have myself examined two fresh specimens of this variety from Lisbon, one alive, received from Sr. F. Mattozo Santos, Director of the Museum Bocage at Lisbon. In the live specimen the crimson-red colour was distributed over the parotoids, the upper eyelids, the throat, the spots at the angle of the mouth and on the sides, and the spot on the forearm and thigh. On the back and tail there was no red colour, but many of the yellow spots were partly bordered or as if washed over in the centre with a dirty grey. In the second specimen the red colour was restricted to the parotoids, the upper eyelids, and the spot at the angle of the mouth. The markings of the back, limbs, tail, sides, throat, and belly being mostly light grey in the centre and on the borders.

On careful examination of the red and grey markings in these specimens, I have come to the conclusion that these are due, not to special pigments in addition to or in combination with the

yellow, as has been supposed, but to the absence of pigment, the pigmentless flesh, highly flushed with blood, being exposed on certain patches and the grey colour resulting from the absence of yellow combined with a small quantity of black pigment.

The largest specimen of the var. *molleri* examined by me measures 109 mm. to the posterior extremity of the vent, the tail measuring 73.

III. Var. *TÆNIATA*.

This variety differs from the typical form in the arrangement of the dorsal spots, which are regularly disposed in two parallel series continuous with the patches on the parotoids, and not unfrequently form two uninterrupted stripes. Even when the two stripes are broken up into as many as 12 spots, these still retain their duplex disposition, not encroaching over the black vertebral line (Area A), or if they do so, as is rarely the case, only on the nape and the posterior end of the body, where they may be connected in **H**-like fashion by a cross-bar. Although in this variety the black often predominates over the yellow, it is not uncommon to find specimens in which the reverse takes place. In cases where the yellow has so far invaded the upper surface as to actually constitute the ground-colour, the black vertebral stripe may be reduced to a mere series of spots, and Werner (**31**, p. 155, pl. vii. fig. 23) even mentions and figures one in which the black is completely absent from the back. The upper eyelid and the parotoid gland are entirely yellow (the yellow patch on the latter rarely broken up), the two spots nearly always running together and often also confluent with the markings on the back, which is rarely the case with the typical form. The sides are usually devoid of markings, and if present they only occur in small numbers. Yellow markings are usually present on the snout, which is but exceptionally the case with the typical form. The spot situated at the angle of the mouth is absent in about 35 per cent. of the specimens. Gular region and lower surface of body with a varying amount of yellow, sometimes entirely yellow with a black spot or bar on the gular fold; the markings have often a tendency to dispose themselves in longitudinal series, thus the belly may be black with a yellow lateral stripe or yellow with one or two black stripes in the middle. Limbs with the black usually predominating; a characteristic yellow blotch near the base of the arm and thigh, and a second on the forearm and leg being constant, and usually larger than in the typical form. Hand and foot mostly black and yellow, the yellow patches being nearly always confluent with those on the forearm and leg. Nearly entirely yellow specimens have likewise yellow limbs with merely 2 or 3 black spots or cross-bars. As on the limbs, the yellow may predominate over the black on the tail and frequently extend to the lower surface, which is rarely the case in the typical form. The two yellow dorsal bands often fuse on the upper surface of the tail.

The colour varies from sulphur- or lemon-yellow to a deep orange.

Some specimens with the markings almost vermilion-red, instead of yellow or orange, obtained by Fr. v. Schweizerbath near Stuttgart, are regarded by her as a distinct variety and named var. *coccinea* (**28**), but this is clearly to be regarded as a merely individual peculiarity, not deserving of a varietal name, and the figure given by her corresponds, but for the colours of the markings, with the var. *tæniata*, the prevalent form round Stuttgart. Considering that the bright markings may vary, in the same locality, from chrome-yellow to a deep orange, the so-called var. *coccinea* represents merely an intensification of a tendency existing in German specimens. Fr. v. Schweizerbath has been informed by Prof. E. Haeckel that such a Salamander was found by him many years ago in the Saal Valley, near Ziegenrück, and it is not unlikely that vermilion-spotted specimens will be discovered in other parts of the habitat of the var. *tæniata*. My father was informed by an intelligent peasant woman in Belgium that on the occasion of her witnessing, in a wood, just before a thunderstorm, a sudden apparition of Salamanders in huge numbers, some among them were distinguished by being marked with red instead of yellow. In D'Orbigny's 'Dictionnaire d'Histoire Naturelle' (**7**, p. 307) allusion is made to a specimen found near Bordeaux, which must have been similar to the one described by Fr. v. Schweizerbath. In Belgium, the markings are of a more or less bright yellow but not orange, and in most cases they form interrupted stripes. In Brittany the markings vary from sulphur- to chrome-yellow. Out of 50 specimens obtained together, within a space of one hundred square yards, last summer at Roscoff, about half had the stripes uninterrupted but varying much in width. M. Ghidini, of the Geneva Museum, having had occasion to examine 500 specimens received alive from Stadtoldendorf in Brunswick, found that about 400 had the two parallel stripes uninterrupted, or nearly so, 50 had them much broken up, whilst the remaining 50 were nearly entirely yellow, with the black reduced to spots or narrow stripes. The specimens from the Harz and neighbouring hills, of which I have seen many, vary in the colour of the markings from chrome-yellow to a rather deep orange.

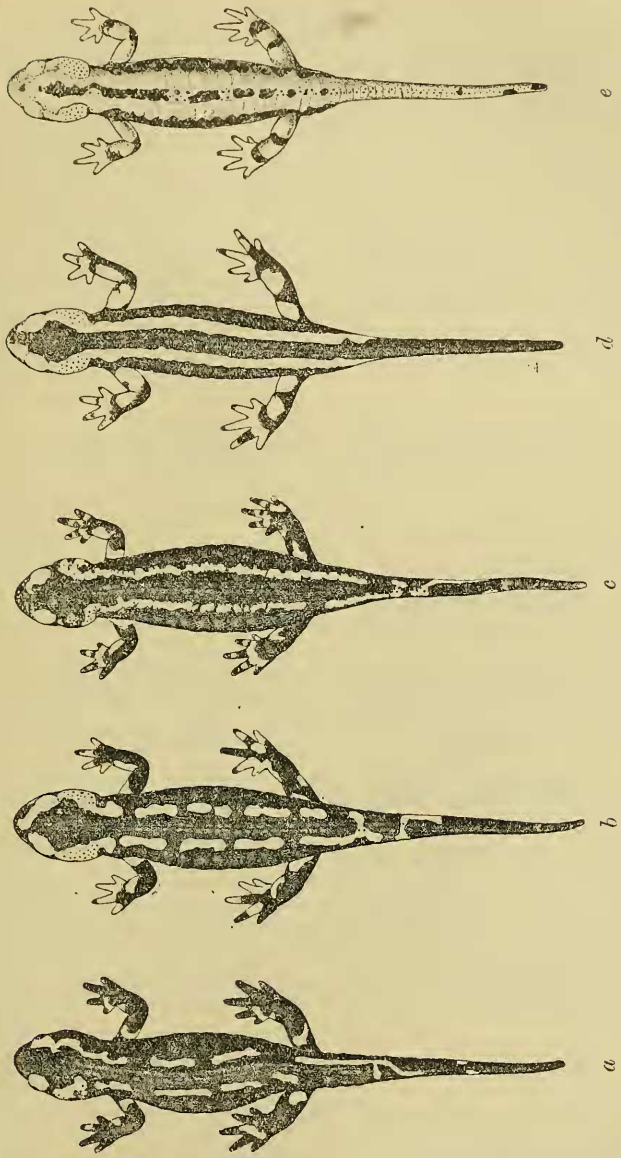
A male specimen from the Harz, in which the yellow colour prevails, is represented on Plate XV.

Figures of the var. *tæniata* are given by Wurfbain (**33**), Gesner (**13**, ii. p. 80), Perrault (**21**, pl. 16. p. 77), Duvernoy (**11**, pl. xl. fig. 1), Mme. Phisalix (**22**, pl. i.), and Dürigen (**10**, p. 577). The descriptions of Leydig (**19**), Lataste (**16**), and Martin and Rollinat (**20**) are also applicable to it, as well as the var. B of Duméril and Bibron (**9**) and the vars. *f* to *k* of Schreiber (**27**).

Five specimens are represented in text-fig. 102, to give some idea of the variations in the markings :—

a, from the Harz, is exceptional in having the spots much reduced in size; spots on the belly numerous, moderately large and roundish.

b, from Maredsous, Belgium, represents the condition most



Text-fig. 102.

The Spotted Salamander. Var. *taeniata*.

frequently met with in France, Belgium, and Germany; the ventral spots are confluent into a broad band on each side.

c, from Roscoff, Brittany, is selected out of fifty specimens as having the spots confluent into two stripes, and yet

	Sex.	Length	O	OP	P	PB	S	OS	Sp.	SECTION I.	SECTION II.	SECTION III.	SECTION IV.	AREA C.	AREA B.	AREA A.	AREA B.	AREA C.	D.	G.	V.
1.	♀	92	+	+	+	+	+	+	5	1.2	1.2.3	2.4.5	2.5	—	2	—	1.3.4.5	—	0—0	+	+
2.	♂	104	+	+	+	+	+	+	2	1.2	1.2	1.2	1.2	—	2	—	1	—	0—0	+	+
3.	♀	107	+	—	+	+	+	+R	2	1.2	1.2	1.2	1.2	—	2	—	1	—	0—0	+	+
4.	♀	108	+	+R	+	—	—	—	6	1.2	1.2.3.4	3.4.5	3.6	—	2.3.6	—	1.4	5	0—0	+	—
5.	♂	94	+	+	+	+	+	+	5	1.2	1.2	2.3	2.4.5	—	2	—	1.3.4.5	—	0—0	+	+
6.	♀	107	+	+	+	+	+	+L	3	1.2	1.2	1.3	1.3	—	2.3	—	1	—	0—0	+	+
7.	♂	80	+	+	+	+	+	—	4	1.2	1.2.3	2.3.4	2.4	—	2	—	1.3.4	—	0—0	+	+
8.	♀	102	+	+	+	+	+	+	11	1–4	3.4.5.6	5–9	10.11	—	1.2.3.5.8.11	—	4.6.7.9.10	—	0—0	+	+
9.	♂	82	+	+	+	—	+	—	10	1–3	3.4.5.6	6.7.8	9.10	—	2.4.7.9	—	1.3.5.6.8.10	—	0—0	+	+
10.	♀	100	+	+	+	+	+	—	5	1.2	1.2.3	2.3.4	3.5	4	2.4	—	1.3.5	—	0—0	+	+
11.	♀	97	+	+L	+	+R	+	+R	8	1.2.3	2.3.4	3.5	6.7.8	—	1.3.8	—	2.4.5.6.7	—	0—0	+	+
12.	♀	97	+	—	+	—	+	+L	9	1.2	3.4.5	4.5.6.7	8.9	—	2.3.5.7.9	—	1.4.6.8	—	1—4	+	+
13.	♀	74	+	+	+	+	+	—	9	1	2.3.4.5	6.7	8.9	3	1.3.5.6.9	1*	1.2.4.7.8	—	2—1	+	+
14.	♂	95	+	+	+	+	+	+	1	1	1	1	1	—	1	1†	1	—	Completely yellow, confluent with belly	+	+
15.	♂	94	+	+	+	+	+	+	1	1	1	1	1	—	1	1*	1	1	0—0	+	+
16.	♂	91	+	+	+	+	+	+	2	1.2	1.2	1.2	1.2	2	2	—	1	1	0—0	+	+
17.	♂	80	+	+	+	—	—	—	4	1.2	1.2	1.2.3	3.4	—	2.4	4	1.3	4	1—1	+	+
18.	♂	95	+	+	+	+	+	+	4	1.2.3	2.3	2.3.4	3.4	—	2.4	—	1.3	—	1—0	+	+
19.	♂	85	+	+	+	+L	—	—	4	1.2.3	2.3	3.4	3.4	—	2.4	—	1.3	—	0—0	+	+
20.	♂	104	+	+	+	+R	+	+L	8	1–4	4.5.6	5.6.7	5.7.8	—	2.4.6.7.8	—	1.3.5	—	0—0	+	+
21.	♂	102	+	+	+	—	+	+	7	1.2	1.2.3	2.3.4.5.6	5.6.7	4	2.5	—	1.3.6.7	—	0—0	+	+
22.	♀	93	+	+R	+	+R	—	—	7	1.2	2.3	3.4.5.6	6.7	—	2.4.6	—	1.3.5.7	—	0—0	+	+
23.	♂	91	+	—	+	—	—	—	8	1.2.3	2.4	5.6	7.8	—	1.3.4.5.7	—	2.6.8	—	1—1	+	+
24.	♀	78	+	+	+	+L	+	+	5	1.2	1.2.3	1.3.4	3.4.5	—	1.4.5	—	2.3	—	0—0	+	+
25.	—	57	+	—	+	—	—	—	7	1.2	1.3	3.4.5.6	7	—	2.3.6.7	7	1.4.5.7	—	0—0	+	+
26.	♂	102	+	+	+	+	+	+	2	1.2	1.2	1.2	1.2	—	2	—	1	—	0—0	+	+
27.	♂	86	+	+	+	+	+	+	4	1.2	1.2	2.3	2.3.4	—	2.4	—	1.3	—	0—0	+	+

* Spot No. 1 forms the letter H in Area I.

† Head and body nearly entirely yellow, the black reduced to an interrupted stripe along the vertebral line, and a lateral band along Area C.

1. St. Malo.
2–3. Roscoff.
4. Armainvilliers near Paris.
5. Beure, near Besançon.
6. Bourg-en-Gironde.
7. Eaux-bonnes, Pyrenees.
8. Maredsous, Belgium.
9. Waulsort, Belgium.
10–17. Harz.
18–19. Lippe Detmold.
20–23. Langenbruck, Swiss Jura.
24–25. Oporto.
26–27. Portugal.

much reduced in width; the small amount of yellow on the parotoids is also very exceptional; the belly is entirely black.

d, also from Roscoff, is remarkable for the regularity of the two yellow dorsal bands; the yellow predominates on the lower parts.

e is selected out of many from the Harz as showing the preponderance of yellow, the black of the upper surface being reduced to a few markings; the throat and belly are yellow with scanty black spots.

Leaving out the specimen from Rome mentioned by Duméril (possibly through some error of locality), the habitat of this variety is restricted to France, Spain and Portugal, Belgium, S. Holland, Germany, and Switzerland. On its occurrence alongside with the typical form, see above, p. 333.

IV. Dr. Kammerer on the Variations of *Salamandra maculosa*.

In the introduction to this paper I have expressed surprise at the distinction between the typical form and the striped form not having been brought out more clearly by the authors who have dealt with the varieties of this species.

This applies also to the most recent worker on the subject, Dr. Kammerer (**14**, p. 69), some of whose highly interesting observations are here reproduced. As he has accompanied them with remarks on the correlation between the coloration and the conditions under which the individuals occur and has drawn provisional conclusions with which I cannot always concur, I have appended my criticisms, inserted in square brackets.

It is possible, he thinks, to establish the existence of local modifications as concerns the intensity of the yellow and its distribution on the black ground-colour. Number, size, and intensity of the yellow spots are in direct proportion to one another. One seldom meets with specimens with few but large spots*.

[This statement is evidently meant to apply to the typical form with isolated spots, but fails to express the state of things in cases when several spots fuse together and are consequently large and few; the very yellow specimens, which are not so very unfrequent, having the spots few in number.]

The contrary, many but small spots, occurs only in the var. *corsica* (*fide* Bedriaga)†.

[This is perfectly true as regards Bedriaga's specimen from

* "Es lassen sich nämlich hinsichtlich der Sättigung des Gelb und der Vertheilung desselben auf der schwarzen Grundfarbe lokale Abänderungen feststellen, die durch eine Menge verschiedenartiger Faktoren beeinflusst zu sein scheinen. Zahl, Grösse und Sättigung der gelben Flecken stehen in direkter Proportionalität zu einander: man findet selten Individuen mit wenigen, aber grossen Flecken."

† "Das Umgekehrte, viele, aber kleine Flecken, tritt nur bei der var. *corsica* Savi (vgl. v. Bedriaga) auf."

Bocognano (now in the British Museum), but we must remember that such a correlation is by no means constant in Corsica, for the figure of the type of *S. corsica*, in Bonaparte's 'Fauna Italica' shows the number of spots not to be in excess of that of a typical specimen from Italy, figured in the same work. The spots on the Bocognano specimen, although more numerous, are not smaller than is usual in specimens from Hungary, Bosnia, Roumania, &c., or, for instance, the one from Italy, so beautifully figured by Rusconi. It is also to be borne in mind that Savi in his original description of *S. corsica* ascribes to it fewer spots than to *S. maculosa*.]

Where there is much yellow this is usually also strongly intensified (dark straw- or orange-yellow), whilst scanty yellow is, apart from rare exceptions, pale (pale sulphur or lemon)*.

[I cannot agree in the least with this statement, as out of over 50 specimens from the Harz Mts. which were recently received at the Zoological Gardens, those in which the yellow constituted the ground-colour were, as a rule, of a paler yellow than those in which the black predominated. Again, in some specimens from Dresden, as my father informs me, and in others from the Harz, with the spots few and of small size, the colour was decidedly orange, whilst in specimens from Brittany and Belgium with much yellow, the latter varied from pale lemon to chrome. A large number of specimens received alive from Hungary (N. Becskeret), mostly with small, or very small spots, few in number, had these orange, not yellow.]

The author then enumerates, with reference to his own material and some indications in the literature, the local differences in connection with the geographical distribution :—

1. In specimens from the hilly districts (Riva, Tyrol, 70–120 m., Schandau on Elbe, Saxony, 130 m.), and in those from the North-German plain (Minden in Prussia, 50 m.) and from the South of France and Spain (*fide* Bedriaga), the yellow is distributed in great profusion, the spots of the upper surface being often confluent into broad longitudinal bands, or even becomes the predominant colour, and in the S. French and Spanish Salamanders the dark ground-colour disappears almost entirely. Besides, the under surface of such specimens is strongly spotted or even entirely yellow.

2. In specimens from Portugal (var. *molleri* Bedriaga) red spots formed of a special pigment appear in addition to the mostly numerous yellow spots, which here also invade the ground-colour.

3. The same remarkable appearance obtains likewise in many specimens from the neighbourhood of Vienna (Hütteldorf, Mödling, Puckersdorf, Hadersdorf, Unter-Tullnerbach), in which

* "Wo viel Gelb vorhanden ist, da ist es gewöhnlich auch stark gesättigt (Dunkelstroh oder Orangegelb), während spärliches Gelb, von seltenen Ausnahmen abgesehen, blass (Lichtschwefel oder Citrongelb) aussieht. Bei einer mässigen Quantität Gelb treten die Flecken bald in dunkleren, bald in helleren Schattirungen auf, jedoch in der Regel nicht bei ein und demselben, sondern bei verschiedenen Exemplaren."

red of different shades (brownish red, greyish red, claret-red, blood-red, vermilion, brick-red) is present, namely on the parotoids, on the forehead and vertex, round the eyes, at the angle of the mouth, on the throat, and occasionally also over the whole body. Otherwise the Vienna individuals are mostly provided with moderately large and moderately numerous spots, the intensity of the shade of which varies to the extent that in different examples from one and the same locality they may be pale or deep yellow.

4. Specimens from the Central Mountains of Germany, the spurs and the lower region of the Alps (Salzburg, 450–638 m., Kaumberg, Lower Austria, 490 m., Meran, Tyrol, 350 m., Villach, Carinthia, 500–600 m., Jenbach, Tyrol, 530 m., Wochein Valley, Carniola, 510 m., Bozen, Tyrol, 250–300 m., Kapfenberg, Upper Styria, 500 m., Wiesing, Bavaria, 750 m., Mondsee, Upper Austria, 480 m., Kufstein, N. Tyrol, 490 m.) show an average condition, *i. e.*, the mostly irregularly formed and distributed spots on the upper surface being moderately large and numerous, those on the lower surface being scanty and pale; all sorts of shades of yellow are observable in different individuals.

5. In specimens from the Alpine region, from the upper limits of the vertical range of the species (Salzburg, 1000 m., Bozen, Tyrol, 920 m., Appenzell, Switzerland, over 1000 m.), the black ground-colour predominates, the yellow spots being small, few, and very pale. The lower surface is usually unspotted. According to Walter Bendt, of Gratz, a specimen obtained on the Schöckl Plateau at an altitude of about 1230 m. (highest altitude on record) had only a few spots which were not of a well-defined yellow, but more brownish.

6. Small number and size of spots are also shown by specimens from S.E. Europe, viz., from Orsova (*fide* Mojsisovics), Montenegro (*fide* Werner), and Athens (*fide* Werner), and generally by Turkish and Greek Salamanders, also by the specimens from the extreme south of the distribution (Haifa, Syria, and var. *algira*).

Not everywhere are the local variations quite constant, viz., there occur in the Alpine region (Alpine valleys up to 600 m., *fide* Werner) rather strongly and largely spotted specimens, whilst in the neighbourhood of Vienna, among an average of strongly spotted specimens, there are also some, if only a few, with small and yellow spots. Indications of red spots on the parotoids, on the inner edge of the upper eyelids, as well as between the angle of the mouth and the lower border of the eye, are also to be found in isolated specimens from Lower Styria and the Bavarian Alps.

An absolute constancy with regard to the multiplicity of the factors which influence the markings, many of which may, of course, counteract one another in the same locality, cannot be expected.

A precise test of the geological, climatic, and meteorological

conditions of the localities of a great number of specimens has shown that the colour-variations can be grouped on a geographical basis * :—

1. A warm climate increases, a cold climate attenuates the markings and their intensity.

[Salamanders from Belgium and the Harz district, with cold climates, in the north of the distribution of the species, have on an average large markings, the Harz specimens in particular being often bright yellow or orange, whilst specimens from S.E. Europe, N. Italy, to say nothing of extreme southern specimens (Syria and Algeria), to which Kammerer himself alludes, have, as a general rule, small and few spots. Specimens from the hilly parts of Belgium, from most French localities, either at sea-level (Boulogne, Brittany, Bordeaux) or at a considerable altitude (Eaux-bonnes, Pyrenees, 750 m.), are absolutely identical in the general style of markings and in their colour, thus showing that climate has no bearing on this character.]

2. Localities with very damp air and soil, provided in addition with a great number of water-courses, favour the number, size, and intensity of the yellow spots, whilst conversely dryness and scarcity of water-courses produce a decrease in these respects.

[One does not well conceive the Salamander flourishing under other conditions than the first. It is difficult to believe that the Salamanders with much yellow, such as we have from Bordeaux, S. Italy, and Asia Minor, are from damper localities than those with small spots from Austria, Hungary, and Roumania. What I have said above of the Salamanders of France is against Dr. Kammerer's contention.]

3. In localities where the sub-soil consists of schists, igneous rock, and sandstone, Salamanders are as a rule more numerous, larger, and more intensively yellow-spotted than in calcareous hills, where they are not found in such abundance; possibly this may bring us back to proposition 2, calcareous hills being always

* "Eine genaue Prüfung der geologischen, klimatischen und meteorologischen Verhältnisse möglichst vieler mir aus eigener Erfahrung und aus Museen durch Belegeexemplare, sowie aus der Litteratur durch Beschreibungen der betreffenden Exemplare bekannt gewordenen Fundorte hat ergeben, dass die Farbenabänderungen an Stelle der geographischen Gruppirung auch in folgender Weise geordnet werden können:

1. Warmes Klima unterstützt, kaltes Klima unterdrückt die Fleckenzeichnung und deren Sättigung.

2. Gegenden mit starker Luft- und Bodenfeuchtigkeit welche womöglich ausserdem reich an kleinen Wasserläufen sind, begünstigen Zahl, Grösse und Sättigung der gelben Flecken, wogegen Trockenheit und Armuth an Gewässern dieselben zurücktreten lässt.

3. In Gegenden, wo Schiefer, Urgestein und Sandstein den Untergrund bilden, sind die Salamander in der Regel zahlreicher, grosser und intensiver gelb gefleckt als im Kalkgebirge, wo sie überhaupt nicht so häufig zu finden sind. Möglicher Weise lässt sich dies auf Punkt 2 zurück führen, indem das Kalkgebirge stets trockener und ärmer an Gewässern ist, als das aus den übrigen genannten Gesteinsarten sich zusammensetzende Gebirge.

4. Ein ganz besonderes Überhandnehmen der gelben Farbe und deren Sättigung, sowie das Auftreten von rothen Flecken, findet auf Lehmboden statt, wogegen auf schwarzen Humus das Umgekehrte obwaltet."

dryer and poorer in water-courses than those formed of the other mentioned rocks.

[I am not sufficiently acquainted with the formations on which the specimens in the museum were obtained to fully discuss this proposition, but I wish to observe, on the testimony of my father, who has examined large numbers of specimens from Belgium, found on Carboniferous and Devonian limestone, and from Brittany, on granite, that Salamanders from these places agree absolutely in the extent of the spots and in the comparatively pale colour of the same as well as in size. This is true also of the Salamanders found over the greater part of France (var. *tæniata*, with markings hardly ever orange), and yet the localities about which we have definite information are on the most different geological formations:—*a*. Ambleteuse, near Boulogne (Kimmeridge and Upper Oolite, clay with lime); *b*, *c*. St. Malo and Roscoff (Granite); *d*. Bordeaux (Pliocene and Oligocene clays); *e*. Marly, near Paris (Oligocene limestone); *f*. Eaux-bonnes, Pyrenees (Cretaceous limestone). This list clearly indicates that, in France at any rate, the subsoil has nothing to do with the coloration of Salamanders.]

4. A quite special increase of yellow colour and its intensity, as well as appearance of red spots, takes place on a clay soil, while, on the other hand, the reverse takes place on black humus.

Dr. Kammerer concludes by observing that the above correlations are subject to many irregularities, and that he would formulate them with reserve, were it not a fact that these irregularities or apparent exceptions are almost invariably to be satisfactorily explained by the simultaneous occurrence of opposed factors in one and the same locality (*e. g.*, water poverty but clay soil, or warm climate but calcareous hills, &c.) and that it is therefore necessary to make a complete investigation of the physical conditions of each separate locality.

[Suffice it to add once more that the large Belgian Salamander, copiously marked with yellow, occurs in great abundance in places offering a combination of the two principal factors which, according to Kammerer, would produce small size and scarcity of markings, viz., a dark soil rich in lime and a cold climate.

It is also important to observe that, contrary to Kammerer's results, our blackest specimen of the typical form is from a hot locality (Ticino) at an altitude of only about 600 metres, our yellowest from the highest altitude on record, 1600 metres (Calabria). It might be objected that in the case of the latter the altitude is compensated by the latitude, but that will not answer, since at a more southern latitude, and almost at sea-level, on the north coast of Africa, paucity of yellow markings is the rule. In the var. *tæniata*, a totally black specimen has been recorded from the Siebengebirge (Rhenish Prussia), whilst the opposite extreme of almost wholly yellow specimens is on record from as distant and dissimilar localities as the Harz, Bilbao, Toulouse, and (?) Rome.]

Since the publication of the above conclusions, Dr. Kammerer has instituted a series of experiments with the object of showing that the colour and dampness of the soil has an influence on the increase or reduction of the yellow markings, and the results of some of the experiments have been recently published, with figures, in the German paper 'Natur' (15).

In view of the geographical distribution of the typical form and the var. *tæniata*, which I have endeavoured to trace from a large material, Dr. Kammerer's results are surprising, for the pictures given by him show the offspring of a female of the typical form, presumably from Austria, to belong to the var. *tæniata*. Considering the enormous number of specimens of the two forms which he has kept in his terrarium, is the possibility excluded of some confusion having taken place? Or may not the male have belonged to the latter variety, and have transmitted his characters to the offspring? Then, again, as to the changes in markings taking place in the same individual in the course of growth, may not some error of identification have crept in? After the study I have made of the disposition of the markings, I can hardly refrain from expressing a doubt as to the middle specimen of the left-hand lower series on fig. 1 being the same as the one to its right, for it will be observed that the two yellow stripes or series of spots are much more distant from each other in the younger stage than in the older, and this is a change difficult to conceive to have taken place in one and the same individual. In fact, were it not for the statement of so high an authority as Dr. Kammerer, whose experiments appear to have been conducted with so much skill, care, and patience, I think I would not have hesitated in pronouncing the two figures in question to have been taken from different individuals.

References.

1. Aldrovandi, U.—De Quadrupedibus Digitatis Oviparis. Lib. i. (Bonn, 1637.)
2. Bedriaga, J. von.—Beiträge zur Kenntniss der Amphibien und Reptilien der Fauna von Corsika. Arch. f. Naturg. 1883, p. 252.
3. ——— Die Lurchfauna Europa's.—II. Urodela. Bull. Soc. Nat. Moscou, 1896 (1897).
4. Betta, E. de.—Monografia degli Anfibi Urodeli Italiani. Mem. Istit. Veneto, xi. 1864, pp. 495, 516.
5. Bonaparte, C. L.—Iconografia della Fauna Italica. Vol. ii.
6. Camerano, L.—Monografia degli Anfibi Urodeli Italiani. Mem. Acc. Tor. (2) xxxvi. 1884, p. 405, 2 pls.
7. D'Orbigny, C.—Dictionnaire d'Histoire Naturelle, xi. (Paris, 1849.) Art. Salamandre.
8. Doumergue, F.—Essai sur la Faune Erpétologique de l'Oranie. (Oran, 1901.)
9. Duméril & Bibron.—Erpétologie Générale, ix. (Paris, 1854.)

10. Dürigen, B.—Deutschlands Amphibien und Reptilien. (Magdeburg, 1897.)
11. Duvernoy, G. L.—Planches du Règne Animal. Reptiles. (Paris.)
12. Funk, A. F.—De Salamandrae Terrestris. (Berlin, 1827.)
13. Gesner, C.—Historia Animalium. Lib. ii. (Frankfort, 1617.)
14. Kammerer, P.—Beitrag zur Erkenntniss der Verwandtschaftsverhältnisse von *Salamandra atra* und *maculosa*. Arch. f. Entwickelungsmech. xvii. 1904, Heft 2.
15. ——— Vererbung erzwungener Farb- und Fortpflanzungsveränderungen. Natur, vi. 1910, p. 94.
16. Lataste, F.—Essai d'une Faune Herpétologique de la Gironde. Actes Soc. Linn. Bordeaux, xxx. 1876.
17. Latreille, P. A.—Histoire Naturelle des Salamandres de France. (Paris, 1800.)
18. Laurenti, J. N.—Specimen Medicum. (Vienna, 1768.)
19. Leydig, F.—Ueber die Molche (*Salamandrina*) der Württembergischen Fauna. Arch. f. Naturg. 1868.
20. Martin, R., & Rollinat, R.—Vertébrés sauvages du Département de l'Indre. (Paris, 1894.)
21. Perrault, C.—Descriptions anatomiques de deux Salamandres. Mém. Ac. Sc. Paris, iii. pt. 3, 1734, p. 77, pl. xvi.
22. Phisalix-Picot, Mme.—Recherches . . . . sur les glandes à venin de la Salamandre terrestre. (Paris, 1900.)
23. Reider, J. E., & Hahn, C. W.—Fauna Boica. (Nurenberg, 1832.)
24. Rösel von Rosenhof.—Historia Nat. Ranarum Nostratium. (Nurenberg, 1758.)
25. Rusconi, M.—Histoire Naturelle, Développement et Métamorphose de la Salamandre terrestre. (Pavia, 1854.)
26. Savi, P.—Descrizione della *Salamandra corsica*. N. Giorn. Lett. xxxvii. 1838, p. 208.
27. Schreiber, E.—Herpetologia Europæa. (Brunswick, 1875.)
28. Schweizerbath, Elise v.—Eine rote Farbenvarietät von *Salamandra maculosa*. Ber. Senck. Ges. 1906, p. 119, pl. iv. Also Bl. f. Aq. u. Terr. Kunde, xx. 1909, No. 24, p. 382.
29. Seoane, V. L.—Identidad de *Lacerta schreiberi* (Bedr.), y *Lac. viridis* var. *gadovii* (Boul.) é investigaciones herpetologicas de Galicia. (Corunna, 1884 [1885].)
30. Sturm, J.—Deutschlands Fauna. Part iii. Heft 2. (Nürnberg, 1799.)
31. Werner, F.—Untersuchungen über die Zeichnung der Wirbelthiere. Zool. Jahrb., Syst. vi. 1892, p. 155.
32. ——— Die Reptilien und Amphibien Oesterreich-Ungarns und der Occupationsländer. (Vienna, 1897.)
33. Wurfbain, J. P.—Salamandrologia. (Nurenberg, 1683.)

EXPLANATION OF PLATE XV.

Salamandra maculosa.—Forma *typica*, ♂, from Lugano; var. *molleri*, ♀, from Portugal; var. *tæniata*, ♂, from the Harz.